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PRECISION GEAR TOOTH CHAMFERING BURRING AND MILLING

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THE CIMATOOL CO.
Dayton, Ohio, U.S.A.



PRECISION GEAR TOOTH CHAMFERING BURRING AND MILLING

• One of the essential requirements of modern noiseless transmission gearing is precision chamfering and burring, which may or may not be combined with tooth recessing.

Cimatool Chamfering Machines have taken these operations out of the luxury class and put them on a sound, low cost production basis. They have provided the essential precision and flexibility to meet the full range of today's requirements. Operations of this kind are now applicable to practically any type of gear, including helicals, hypoids and internals. Sizes up to 22 inches in diameter can be handled on standard Senior machines, and larger diameters can be processed on special machines. Chamfering, recessing and milling may be accomplished automatically on practically any specified number and grouping of gear teeth. Tooth end profile may be given a wide variety of forms ranging from a regular wedge to a combination of circular arcs. In fact, the flexibility of these machines is practically unlimited.

Sound departures from conventional design have made it possible to overcome previous limitations on speed, accuracy and effectiveness. For instance, gears up to 13 inches diameter are being processed on Normal Duty machines at a speed as high as 600 teeth per minute. As previously noted, larger gears can be handled on the Senior machines.

Production for any given job will, of course, depend on the type of machine used, character of the operation, size of the gear and the amount and characteristics of metal removed.

CIMATOOL CHAMFERING MACHINE TYPES

• There are three Cimatool Chamfering Machine models (A, B and C)—also three interchangeable types of work heads (3½, 4 and 5). This provides a range of combinations to satisfy any condition that is likely to develop—an unmatched range in types and flexibility. Model "A" carries 1 cutter head and 1 work head; Model "B" 2 cutter heads and 1 work head; while Model "C" has 2 cutter heads and 2 work heads.

On all models either hydraulic, air or manual clamping is available. Rapid traverse is optional. When incorporated it may be controlled manually or hydraulically. In fact, machine control can be made fully automatic or automatic to any desired degree.

STATIONARY CUTTER HEAD

• Instead of presenting the tool to the work, the cutter spindle of a Cimatool Chamfering Machine rotates in a stationary position and the work is presented to the tool. It is therefore practicable to use very much heavier spindle mountings which offer ideal cutting conditions. All cutter spindles accommodate both the hollow-mill and the pencil cutter.

WORK HEAD

• The work head is a very important element and ingeniously simple. It incorporates all the mechanism necessary for the control of the machining operations. It is independently driven. Its indexing movement is mechanically positive (always locked in mesh). It is not only quicker to set up, but it offers higher production speeds.

The work gear spindle moves forward and backward in instant response to the rotation of a guide cam located in the head assembly. The shape of the cam may be varied infinitely to provide almost any rate of cutting feeds, and in the case of pencil cutter setups also provides an almost infinite variety of chamfers.

As previously mentioned, there are three types of work heads. The No. 5 head, which is recommended for heavy duty, high production, extremely high precision work, is simple and rugged. It has only three rotating shafts. Correspondingly, the possibility of backlash has been practically eliminated. This head may be used for either pencil cutter or hollow-mill chamfering.

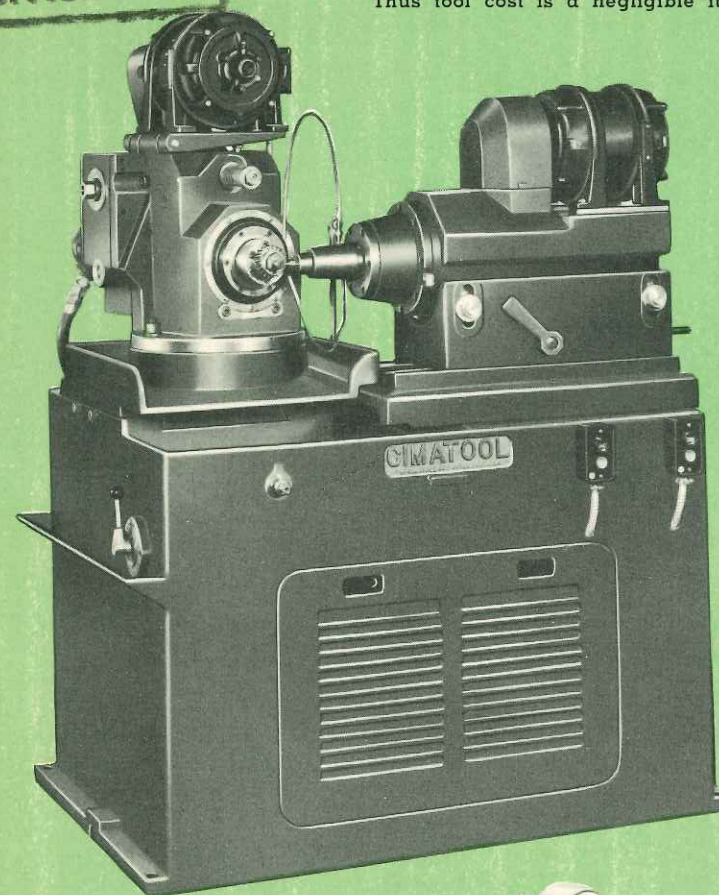
In changing hollow-mill jobs the only requirements when using the No. 5 head are a new work adapter and possibly a new indexing worm gear set. The worm gear must have the same number of teeth as the part being chamfered.

The No. 4 head is a general purpose unit for hollow-mill chamfering only. Its change-over requirements are similar to those of the No. 5 head.

The No. 3½ head, like the No. 5, handles either pencil cutter or hollow-mill work. It usually requires no change-over besides adapter, except in case of a pitch change, when only a master drive gear of the same pitch is needed. It is simple in design but has a few more parts than the No. 5 head. The No. 3½ head is recommended chiefly for short runs where change-over time is extremely important.

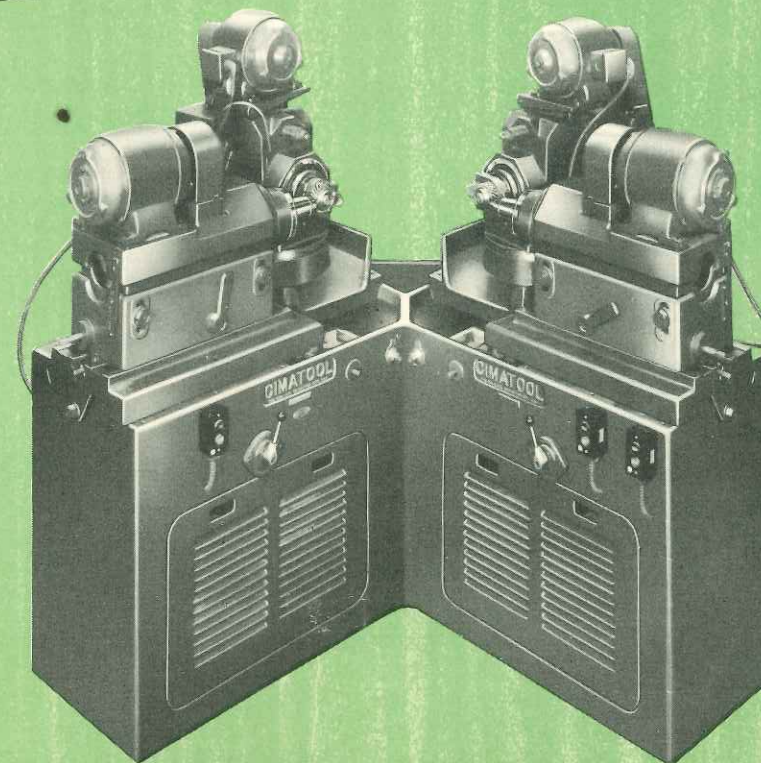
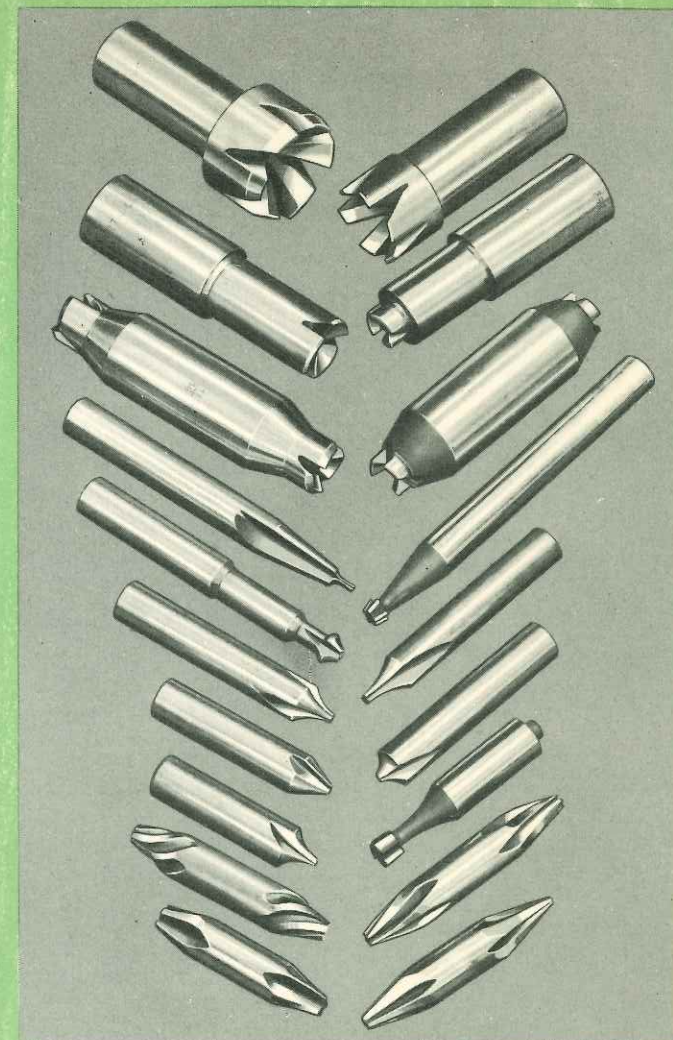
Machine design is of course subject to change without notice.

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• Fig. 1—Cimatool Model "A" Chamfering Machine with a No. 5 Head. The work head swivels on a dialed base and is adjustable in both directions in a horizontal plane. Cutter spindle is adjustable vertically as well as to and from work horizontally. All elements subject to wear are provided with take-ups.

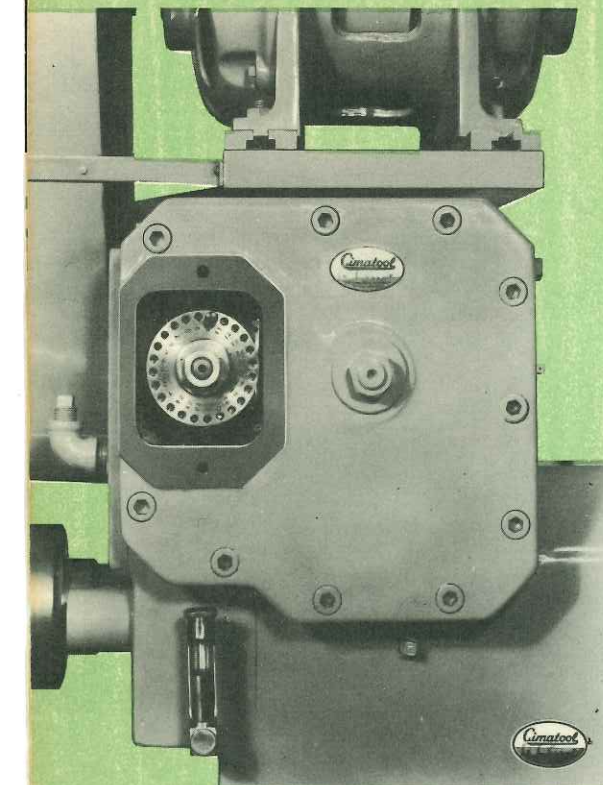
• Fig. 2A—Pencil cutters and hollow-mills used on Cimatool Machines are heavy duty tools in every respect. Properly handled any such tool can be reground as many as 25 times. Thus tool cost is a negligible item.



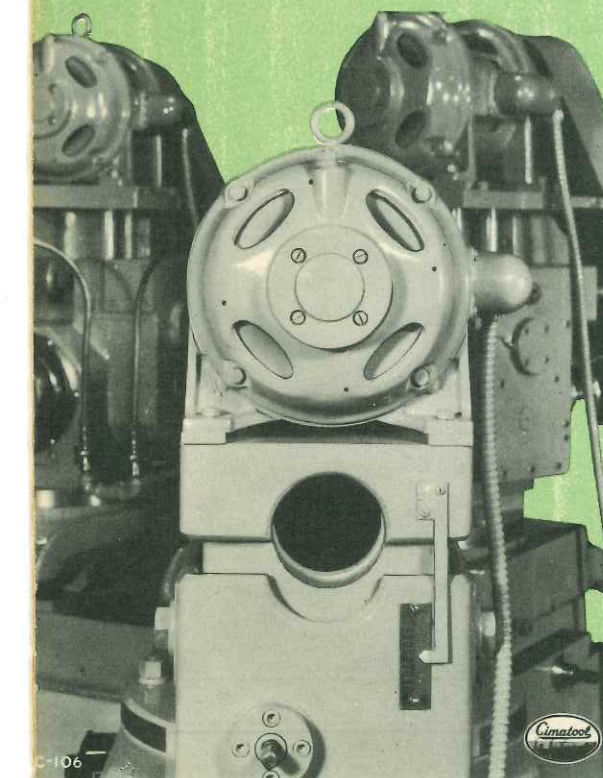
• Fig. 2—Cimatool Model "C" Chamfering Machine with No. 5 Heads. This unit handles two work gears simultaneously—or it may handle two separate chamfering operations on the same type of gear. One spindle is loaded while the other is cutting.

SIXTEEN CIMATOOL ADVANTAGES

- 1 Both indexing and feed motions combined in same precision work head.
- 2 Simplicity—fewest moving parts.
- 3 Interchangeability—uses both hollow-mill and pencil cutters.
- 4 Speed limited only by cutter capacity.
- 5 Quick change index worm set.
- 6 Rapid timing mechanism.
- 7 Indexing mechanism positively locked in mesh at all times.
- 8 No backlash—no lost motion.
- 9 Precision adjustment of cutter spindles.
- 10 Cone worm drive.
- 11 Vertically adjustable cutter head.
- 12 Adjustable work head wear plate.
- 13 Forced feed lubrication to all work head bearings.
- 14 No universal joints — no exposed unsightly shafts.
- 15 No pawls and ratchets—no teeth can be skipped.
- 16 Operator has unobstructed view of entire operation.



• Fig. 3—Timing adjustment on a No. 4 Head.



• Fig. 4—Vertical adjustment of the cutter spindle showing the graduated scale.

INDEXING

- The work is automatically indexed to present in turn practically any number of selected teeth or any grouping of teeth to the cutter.

In both types of machine, indexing is accomplished in part by the action of a worm and a worm wheel. This eliminates all of the disadvantages of ratchets, pawls, loose dogs, a variety of index plates, etc. The mechanism accomplishes a smooth, even indexing, gradually increasing in speed, reaching a peak and slowing down again at the end of the indexing movement. Thus the action is both smooth and POSITIVE. No index plates to be broken, no teeth can be skipped, and the possibility of undesirable changes in timing during a run is eliminated.

A combination of this method of indexing and the reciprocation of the work, all in the same head, makes it possible to completely eliminate universal joints, flexible shafts and other troublesome elements. There are no exposed shafts or crank arms on Cimatool Machines. The result is a cleaner, simpler, more effective design throughout. This construction also permits utilizing the reciprocating action of the work spindle to actuate a built-in oil pump, which provides forced feed lubrication to every rotating part and bearing surface in the work head.

FLEXIBILITY OF DRIVE AND CONTROL

- It will be noted from the accompanying illustrations that each work head is provided with its own drive unit in order to secure maximum simplicity and flexibility. This is a standard constant speed motor belted to an integral reduction unit. Simple pulley size changes provide an infinite range of operating speeds. This arrangement results not only in a more compact unit, increasing precision and reducing backlash, but it facilitates ample and effective lubrication.

The work cycle may be controlled manually, automatically or semi-automatically, as desired. Under manual control, spindle rotation and work head reciprocation are started by means of push button switches; clamping the work is accomplished by closing a hydraulic valve; bringing the work up to cutting position by a second hydraulic valve. At the end of the cycle the machine is stopped manually and the operator removes the work.

When fully automatic, an ingenious timing mechanism is utilized which carries the machine throughout the complete chamfering cycle, without further attention from the operator, and automatically stops. This completely eliminates the overcutting of any teeth and resulting inaccuracies in depth of chamfer. Semi-automatic control may be arranged to combine as many of the above functions as desired. The character of control should always be specified in inquiries.

All hydraulic control equipment is housed in the machine base—no outside tanks or auxiliary equipment is needed.

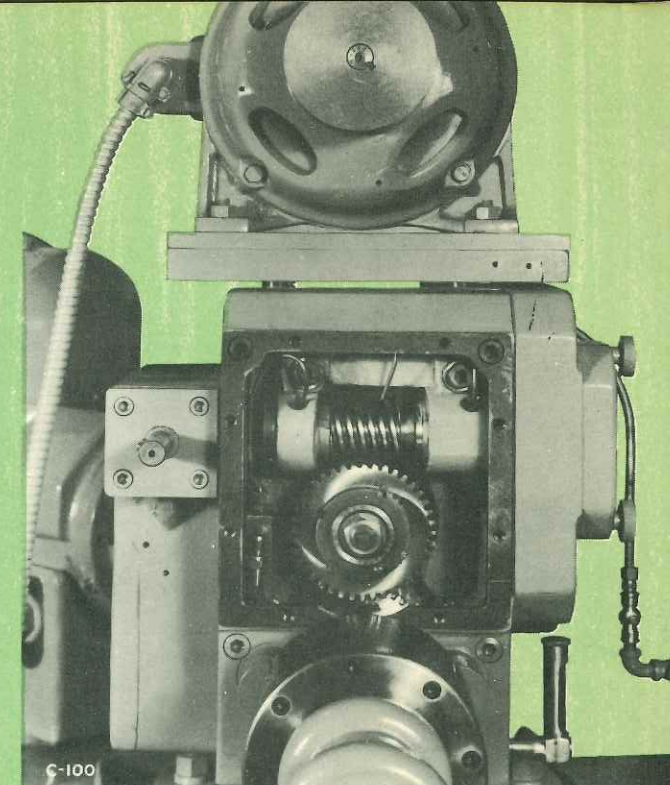
ADJUSTMENTS

- Complete adjustments are provided on cutter heads and work heads so that practically any type of set-up and any kind of chamfer is easily attainable.

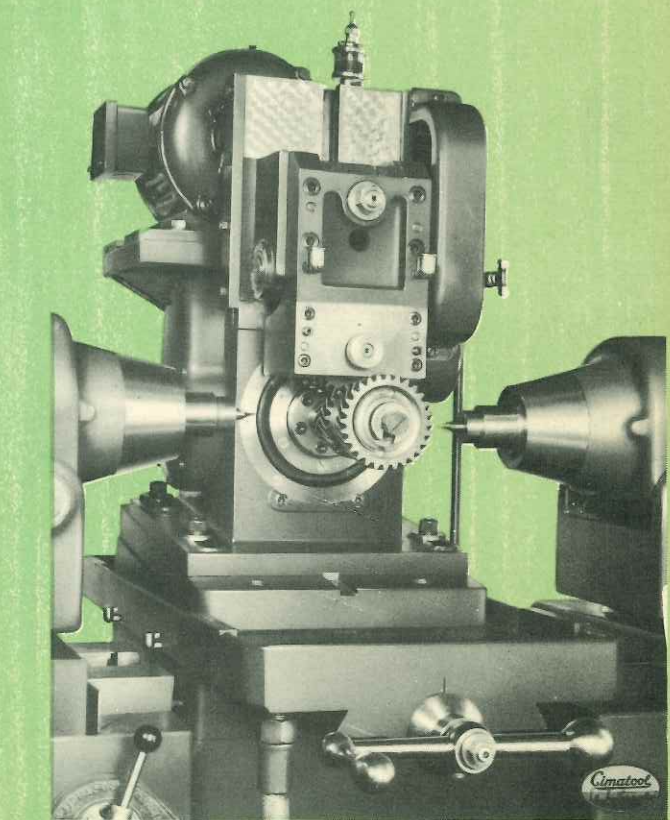
When changing jobs, speeds may be altered by a quick change of V pulleys. All wearing points have take-up adjustments to compensate for wear.

The work head is reciprocated on three flat ways, one of which is quickly adjustable vertically to provide a take-up and assure satisfactory bearing at all times.

The work ends of arbor and spindle are entirely unobstructed for rapid loading and tool changes. All controls are conveniently reached and set-up adjustments readily accessible.

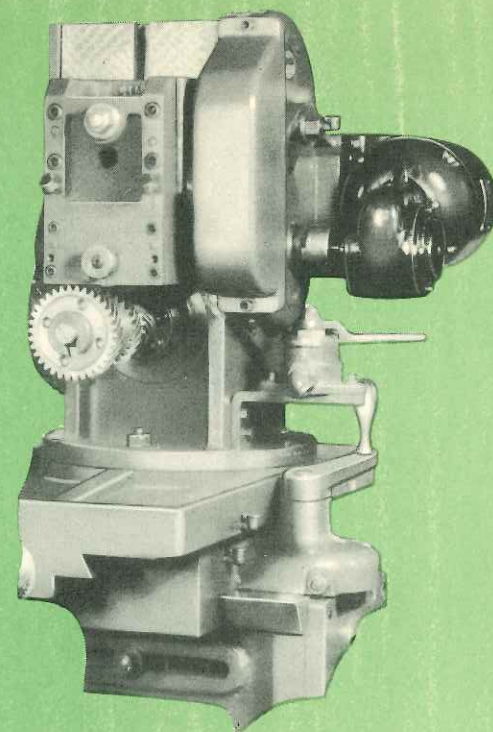
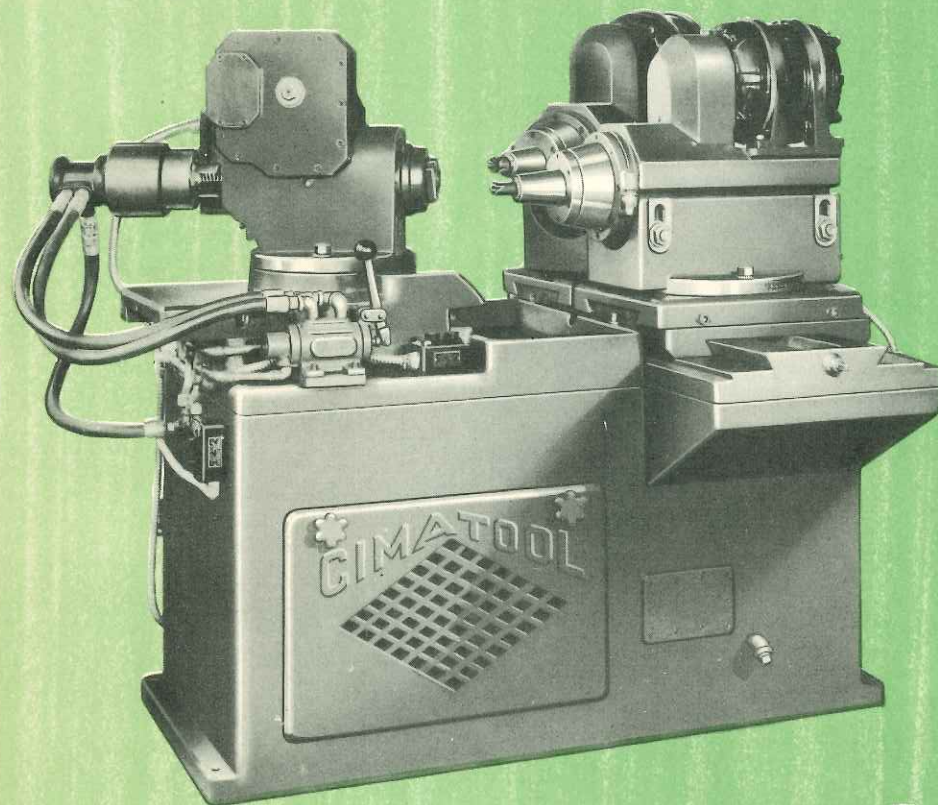


• Fig. 6—Indexing mechanism of the Type 4 Head incorporates a worm and worm wheel to make indexing a perfectly smooth, positive operation that remains accurate and remains in time regardless of the operating speed of the machine.



• Fig. 7—Close up of work arbor (No. 3 1/2 Head) and cutter spindles. Note the accessibility of each for rapid loading, unloading and tool changes.

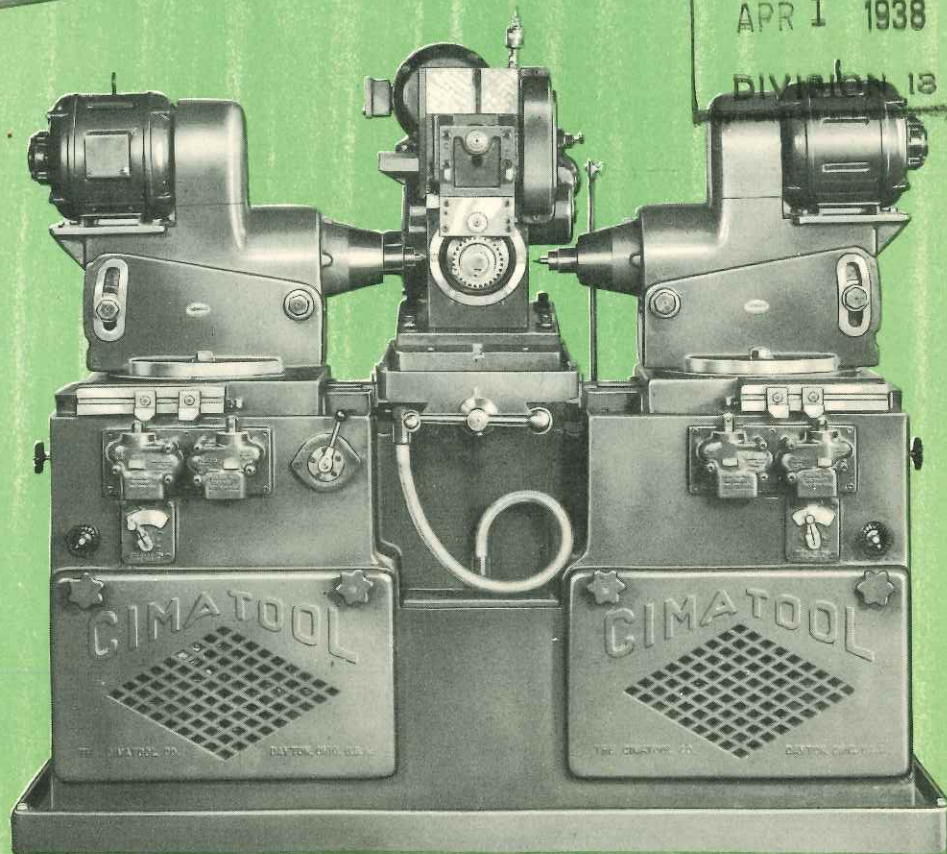
• Fig. 8—Cimatool Model "B" machine with No. 4 Head. Both spindles cut simultaneously. When chamfering a ring or bevel gear, one spindle may be set to handle the inner face while the second cuts the outer face. Where all chamfering is confined to one face, each spindle handles 180° of the circumference. Thus chamfering is completed in half a revolution of the work gear.



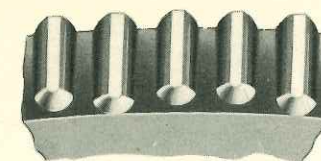
• Fig. 10—With this type work head, changes in number of teeth only, require no change except, of course, the adapter. If a change in pitch is made, usually only a drive gear need be changed. This minimizes change-over and makes the above work head ideal for most short run production.

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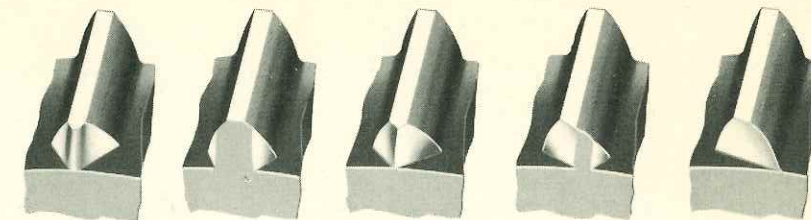
• Fig. 9—A Model "B" machine with a No. 3½ Head. This unit is provided with full hydraulic control. Each spindle handles half the circumference of the work gear being chamfered. Spindle heads swivel in a horizontal plane while spindle adjustments in the vertical plane are accomplished by the arc and pivot mounting. The work head is carried on a saddle and knee which provides adjustment from front to back.



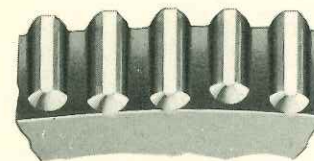
SPUR GEARS



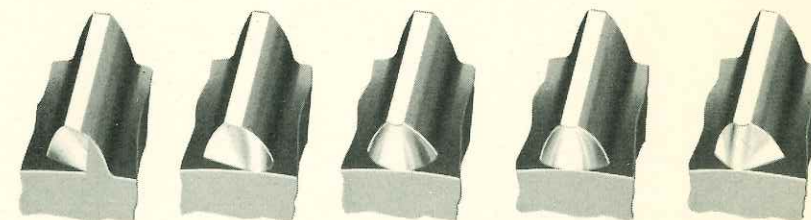
Group A
Relieving and Rounding



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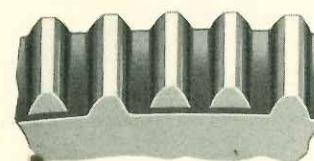
Group B
Relieving and Rounding



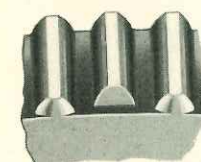
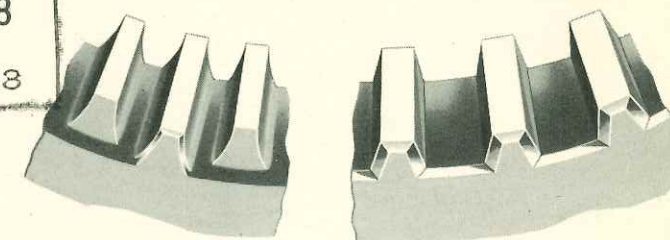
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INTERNAL GEARS

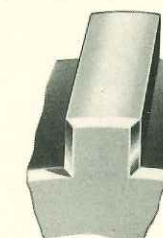


Group C
Relieving

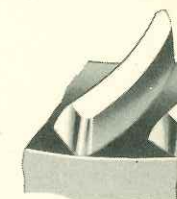


Group D
Relieving and Rounding

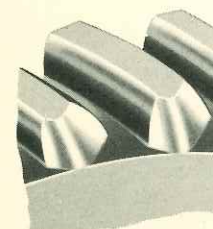
SPLINE



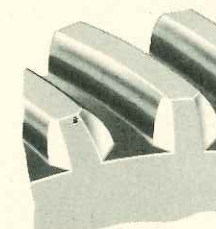
SPIRAL



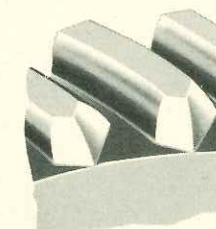
HELICAL GEARS



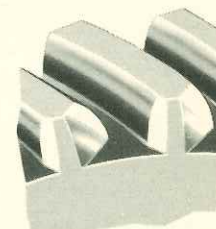
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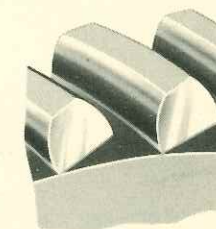
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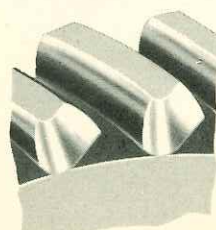
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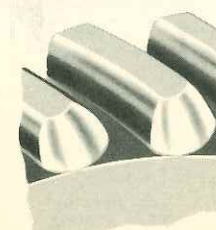
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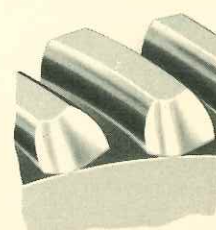
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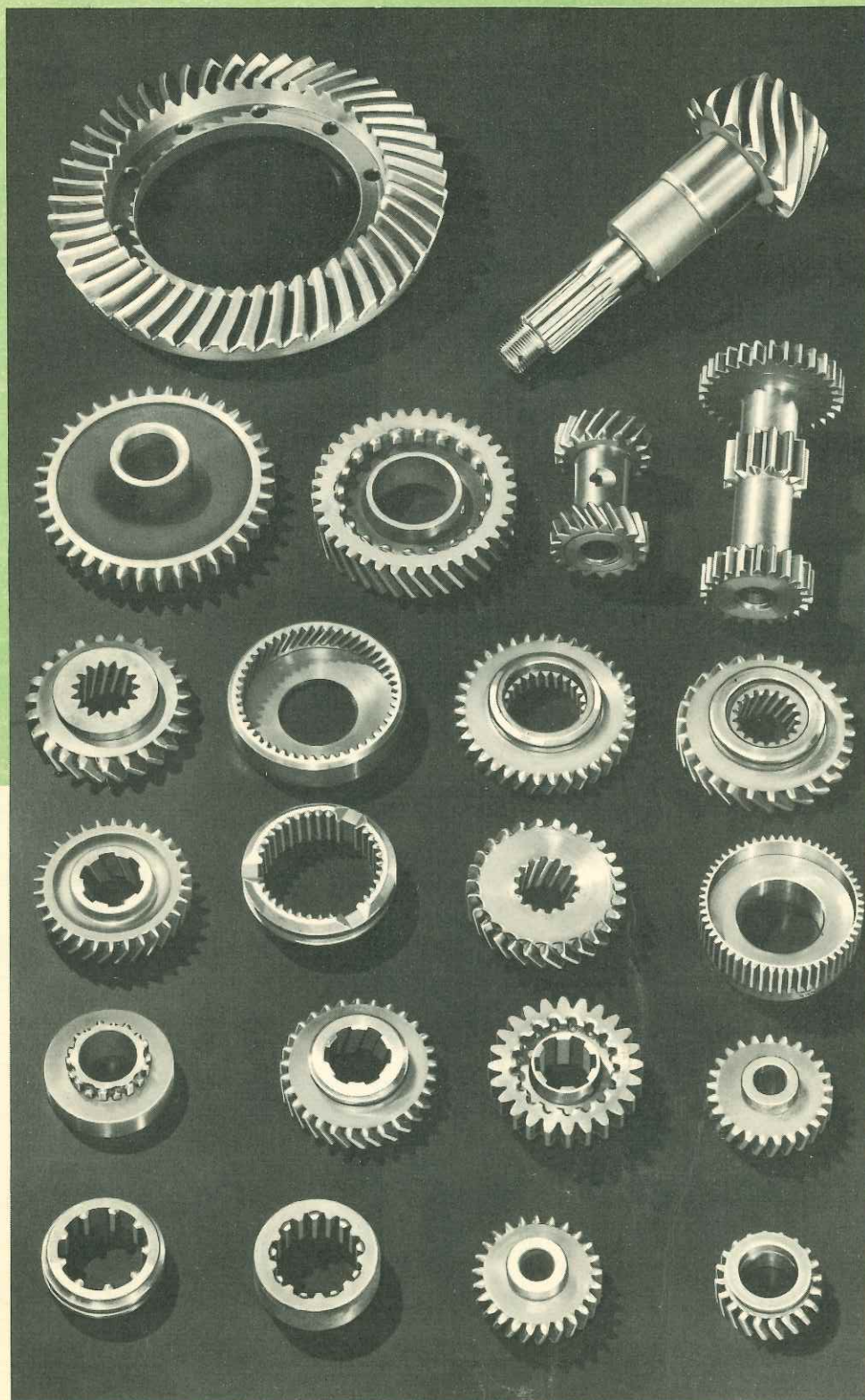
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